



# DID YOU KNOW?

## LOWER THE DISSIPATION FACTOR BY INCREASING THE SIZE OF HIGH VOLTAGE CAPACITORS

### How Does a Ceramic High Voltage Capacitor Disc Get Designed?

Typically, the dielectric constant of the ceramic material used is one of the key parameters when designing the ceramic disc for a high voltage capacitor of a certain capacitance value. The height of the disc is defined by the voltage strength of the material, which means that to achieve a certain voltage rating, the disc needs to have a certain thickness or distance  $d$  between the electrodes (thickness of dielectric material between the electrodes). To reach a certain capacitance value, the electrode size  $A$  gets calculated using the height and the dielectric constant  $k$ . This gives the diameter of the disc.

$$A = \frac{C \times d}{k}$$



$$C = \frac{k \times A}{d}$$



The dielectric constant  $k$  is a material parameter, meaning its depends on the ceramic material chosen for the design. To design the perfect part, the designer needs to find the best solution, looking at advantages and drawbacks of the material to best fulfil the customer requirements for the component in terms of capacitance, size, voltage strength, dissipation factor, and other parameters, e.g. partial discharge.

### Dielectric Constant vs. Dissipation Factor

Increasing the dielectric constant  $k$ , by choosing another material, seems to be the easiest way to decrease the size of the capacitor; however, as a rule of thumb, the higher the dielectric constant, the higher the dissipation factor. To reduce the dissipation factor, in some cases it might be better to reduce the dielectric constant and choose a material with lower  $k$  to take advantage of lower self-heating.

### Vishay Is Prepared

We can offer class 1 ceramic materials with quite low dissipation factors for high voltage capacitors. Due to the low  $k$  of such materials, circuit developers should be aware that the dissipation factor can be reduced significantly, although the space needed for such a component might be slightly bigger.

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